Appendix H

White Paper

Geo Referencing and CADD Documents

In order to gain information on a large geographical area occupied by many different buildings, it is required to have some sort of common access to building drawing information that is geospatially correct. Having general GIS information on the area does not include necessary information such as facility entrances, exits, service areas, building structure, building population distribution/circulation or building materials that may be important to a study. (Large glass areas are very vulnerable, steel is weak when exposed to fire, areas with wood will spread fire, masonry walls can collapse when shaken.)

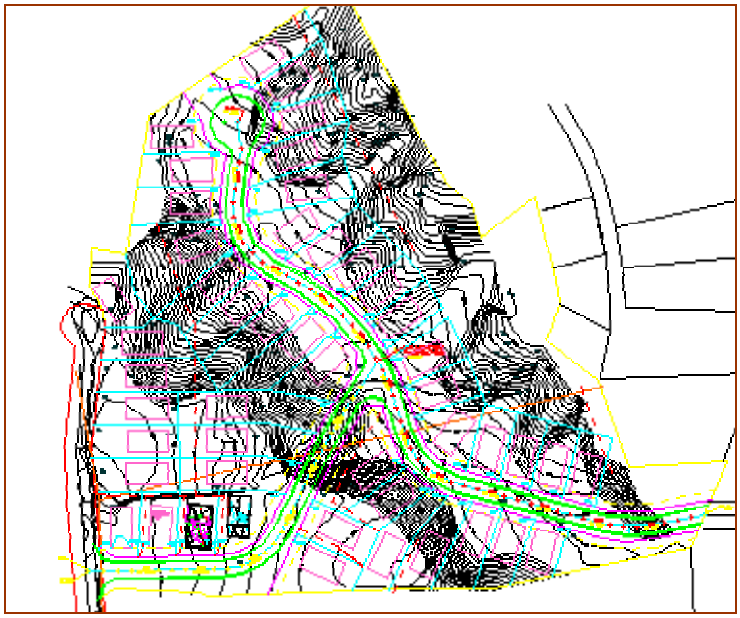
It is now considered necessary to incorporate building drawing information into a GIS drawing that is geospatially correct. Since few people are adequately trained to know what should be done to create the correct geospatial location for a project file, the question has been how and when to incorporate geospatial information.

Having the project designed initially with geospatial coordinates, and following through all engineering and facilities drawings based on the same geospatial information is at best inconvienient and highly unreliable. Major errors can result with many people contributing drawings to a model file based on an unfamiliar coordinate system. The possibility of all Architects and engineers creating an entire set of drawings with the building rotated 43.75 degrees or 176.48 degrees or 315 degrees to match the real spatial orientation is practically impossible. To attempt to require this as a current business practice would be very expensive and inefficient and also is also unnecessary.

There is a sequence that allows a drawing to have the corrrect geospatial location and can be created by using a single qualified User to make the connection between the standard architectural and engineering drawings and the GIS drawing.

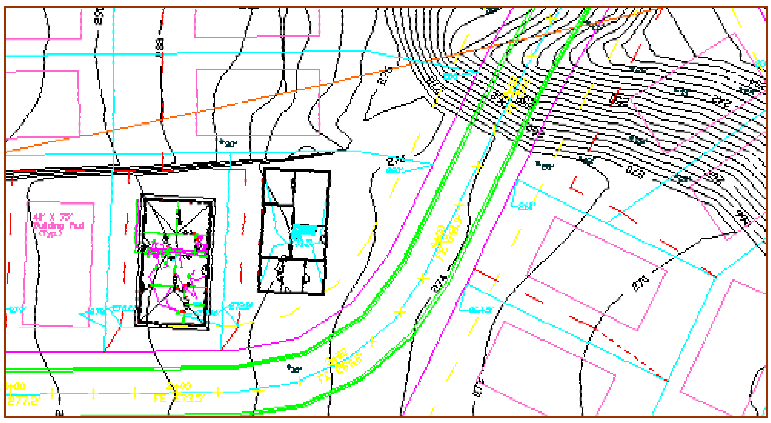
An architectural drawing can (and should) be created using a common model origin point that is not geospatially located, and still be retrieved into a geospatially correct drawing using the process as outlined in the following description.

Dwg A. Geospatially correct Site Plan



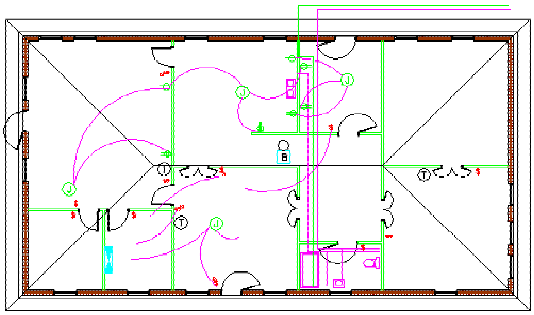
The GIS Site plan above shows the proposed development, created in AutoCAD MAP©. House floor plans were created in AutoCAD Architectural Desktop© and brought in as an externally referenced file. This is the same as linking the files, in that it allows changes in the original file to be included in the file that references it. Enlargement of a section of the development with floor plans shown below with referenced or linked floor plans attached to the drawing.

Dwg B : Enlargement of Floor Plan

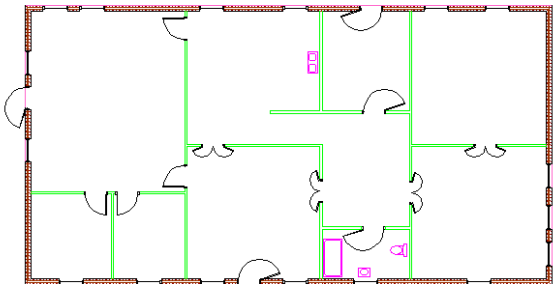


The building's Architectural and engineering plans were created with a common origin reference point for the model file, but not Geographically referenced (Dwg C and D below). This allows all project drawings to be referenced directly between each other without any translation. The architects and engineers are not required to know how to create a drawing that is geospatially correct, but are only required to keep all drawings relative to a single project origin point. There are no requirements on where this point is located.

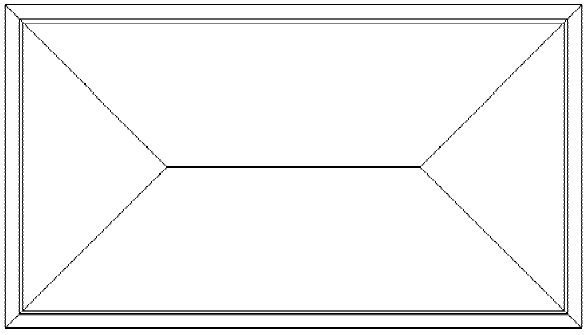
A Composite drawing file is created that contains information from the main set of drawings that are linked or referenced in. This drawing is independent of both the main set of drawings and is used only for a basis for including information in the final GIS document. To include information at this point using reference files requires no understanding of GIS or of the real geospatial location. A reference file is brought in at a common project or model origin point. For all the project drawings, this point is the same, allowing multiple floors as well as the engineering drawings to drop in over each other.



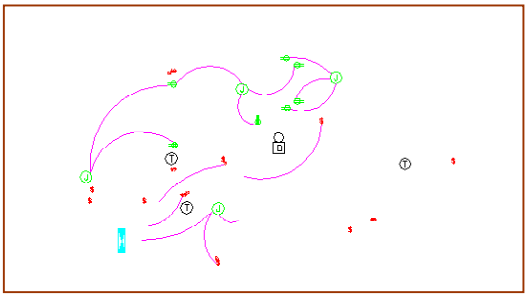
Dwg C : Composite Plan:
Floor Plan, Roof Plan, Electrical, Plumbing



Dwg D : Floor Plan:
Walls, Windows, Doors, Plumbing Fixtures

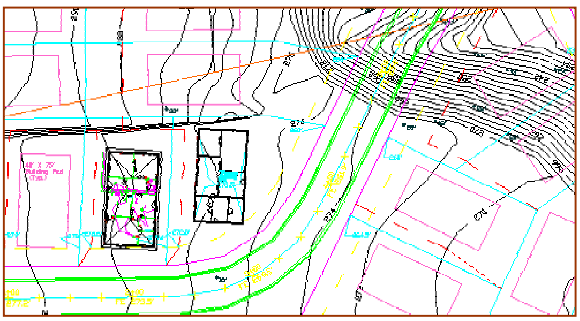


Dwg E : Roof Plan:
Roof Plan Drawing Information



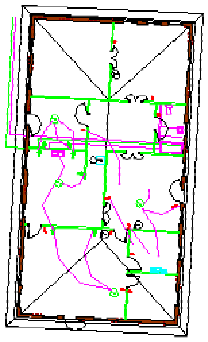
Dwg F : Electrical Plan:
Electrical Drawing Infornmation

A new geo referenced drawing can be created that references the existing composite drawing. The georeferenced drawing would be created by someone with an understanding of geospatial coordinate systems, and could accurately orient and position the referenced file into the real world coordinate system. This is the prepared file that would allow direct reference into another spatially referenced file.



The drawing to the right shows two drawings referenced into the main development (also geospatially correct) at the correct geospatial location. The information contained within the

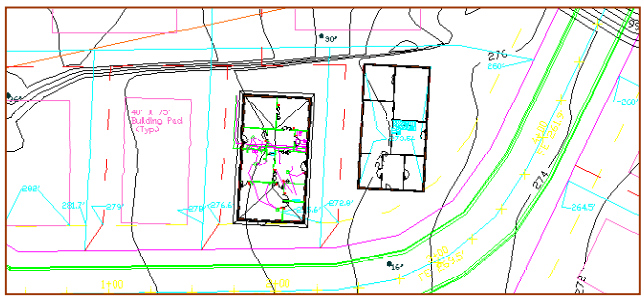
smaller drawing is dependant upon the original composite drawing. Additional reference drawings can be added to the composite and will automatically become accessible to the final drawing.



Dwg H : Geo Positioned Composite Drawing

Geo Positioning drawing created by qualified person to show real world spatial location.

The Composite Drawing created by others is externally referenced into the Geo-positionally correct drawing, and given the correct real world position and orientation. A new location point and angle needs to be set to give the drawing a correct GIS location.



Dwg J : Site Plan

The Geo Postionally correct drawing is referenced directly into the site plan without any modifications to scale, orientation or position.

Steps to integrating the standards drawings into the geospatially correct location:

Create building drawings according to a common project origin point. (A model file origin point). In this instance, the Architectural Desktop package was used to design the floor plan.

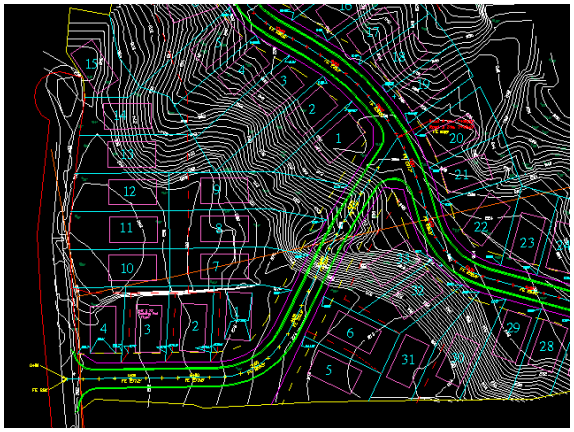
Create a Composite drawing containing no information except referenced file information that is desired to be shown in the final geospationally correct GIS drawing. Each drawing that is referenced in is located at the same model origin point and at the same angle and scale, avoiding potential operator errors from incorrect values. This drawing is dynamic, and will be changed as needed with referenced drawings added or dropped from composite.

Ie: To show the Architectural and plumbing plans in the development site plan, the User would remove the reference file for other drawings that may be connected. The development plan would then have have referenced drawings reloaded to update the current information for only the Plumbing and Architectural information.

The next step is the critical step in relating the other drawings to the correct geospatial position. Someone such as a surveyor or engineer familiar with GIS will need to use the previously composed Composite file and reference that in to the new drawing that will be geospatially correct. The referenced drawing will need to be correctly positioned (with real GIS locations, and given a real-world angle for orientation). If the units used for the Composite are feet and inches and the units used for the plan are in decimal units, the a scale factor will need to be applied to the Composite drawing of 1/12 for the X and Y and Z insertion value.

The newly created Geospatially correct drawing can then be referenced directly into the final development site plan without any further position or orientation change.

If changes are made to the original floor plan or electrical plan or plumbing plan, then these changes are brought into the final GIS plan since it is dependant upon the other drawings to provide the information, and a separate, independent document is not created.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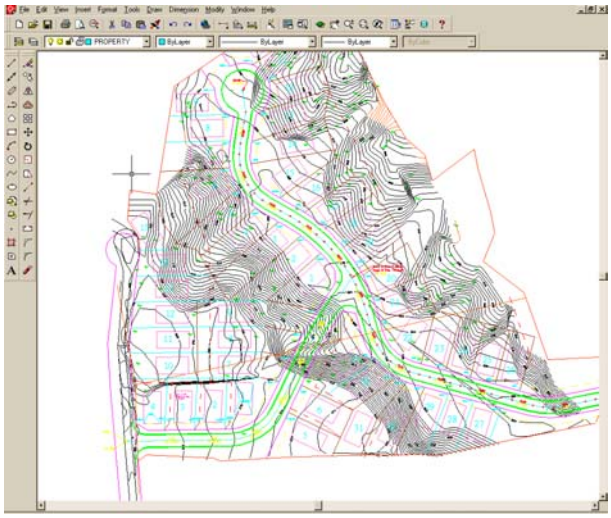
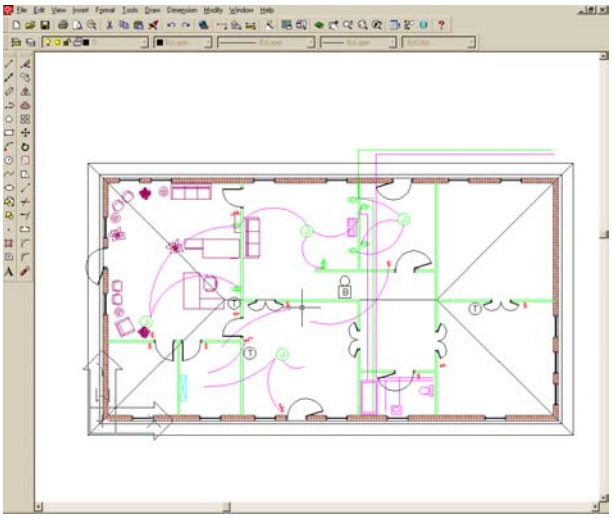
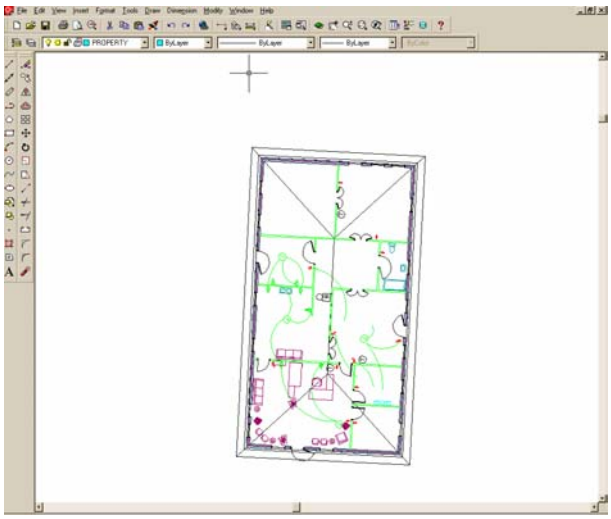


⇦ The site plan created at the correct geospatially location (the coordinates are geospatially correct).



COMPOSITE DRAWINGS⇨
The floor plans for each Lot are created at a model origin point (common for each individual project or Lot but not geospatially correct). All project drawings can be referenced into this single composite drawing.



⇦GEO SPATIAL COMPOSITE
The composite floor plan for each lot brought into a GeoSpatial drawing that is created

GEO SPATIAL DRAWING⇨
The floor plans for each Lot are created at a model origin point (common for each individual project or Lot but not geospatially correct).